# MASTERING INNOVATIVENESS POTENTIAL: THE RESULTS OF AN EXPERT CONSULTATION

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**Abstract:**

A better understanding of innovation process engineering is still needed. Studies on innovation process engineering modeling represent a key step in enhancing this knowledge. This article suggests a four level approach to analyzing innovation. At each level, the models and research methods are different. This article goes into deeper detail about one of these four levels: the enterprise. More precisely it presents a description of the innovation process through thirteen attributes. This representation model has been analyzed by a panel of researchers and practitioners. We present the results of this delphi type validation step.

**Keywords:** innovation, process, modeling

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## 1. Introduction

Innovation has become a major industrial challenge for firms that want to move out of the competitive field of cost reductions. Much research is thus orientated towards the study of phenomena linked to innovation in firms, in order to develop knowledge. Among the scientific publications in international literature, one can find very different approaches.

Some authors insist on the strategic and economic aspects of innovation: for them, innovation is linked to the successful launching of a new product on its market. Other authors describe innovation as an informational or decisional process, by privileging the individual study of projects. These visions of innovation can be linked to schemes that consider innovation as a succession of unitary operations for "processing" an idea in order to transform it into a new product. On the other hand, some research on cognition tackles innovation by questioning traditional modes of reasoning and the development of new representations of objects. Out of the box thinking and the resulting paradigm shifts would thus constitute the major elements of innovation (Buckler,1996). One can also cite works considering innovation as the process of adjustment between firms seen as complex adaptive systems and an evolutionary environment (Pascale, 1999).

Facing this multitude of approaches, international literature does not refer to integrator models. Our aim is thus to elaborate representations facilitating the description of innovating processes observable in situ, and which take into account the different visions we have summarized above.

In this article, we will describe our working hypotheses successively, and present a functional approach to innovation and the validation steps we have followed.

## 2. Hypothesis

Our fundamental hypothesis will consist in considering innovation as a process. Indeed, innovation can be considered as a non-linear chain linked model. Its outcome is a specific, tangible and describable object. As a result, innovation is a process which therefore has all the proprieties associated with this concept:

- a temporal dimension including boundaries, finality and information flows. In our case, the boundaries relate to the beginning and the end of a given project. Moreover, an innovation process puts into relation several activities, which need time, and data transfers. Finally, it induces a change in short-term strategy as well as in long-term strategy oriented toward seizing new opportunities.
- a relational dimension: routines and non routines. An innovation process mainly corresponds to a knowledge creation process. A paradox can be highlighted between optimization (reinforcing technical capacities and thus generating routines) and newness (changing the referential at a global level in the firm in order to break with routine and as a result favor creativity).
- A productive dimension: by transforming resources into products. Innovation is an added value process that consumes material and immaterial resources in order to transform an idea into a new product or service (Tomkovick, 2000).
- A cooperative dimension: through the sharing of knowledge. An innovation process necessitates both collective and organizational learning, because innovation is located in each person involved and has to be capitalized and shared for other use.

Particularly, the innovation process may be defined with the following characteristics:

- it is a contextual organized process. In fact, the nature and quality of both the process and its results are highly dependent on the external environment of the company and on the culture of employees (internal environment).
- uncertainty is a major aspect of innovation. Evidence of a necessary constructivist approach in SME's technological innovation management emerges from in situ observations (BOLY et al, 2003).
- A complex process: numerous informational and decisional flows are interconnected (Cooper, 2001).
- A federate process: all company departments and, more generally, all relations between the company and its partners, are involved.

Our second hypothesis consists in considering that the innovation process is fundamentally multi-dimensional. We propose to distinguish four research levels of the innovation process (figure one).

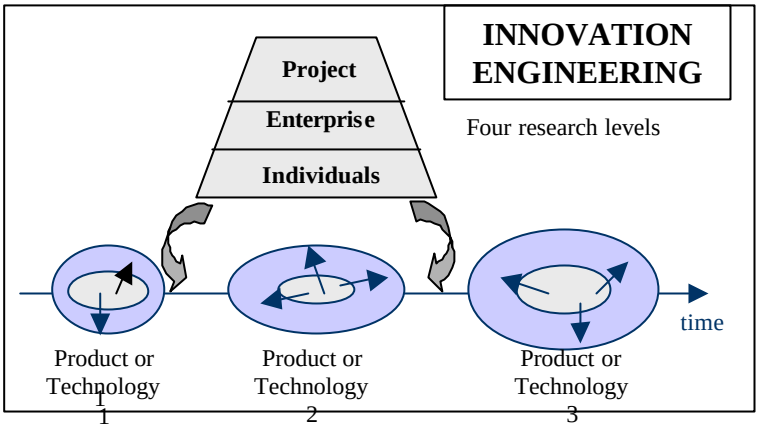


Figure one: The four levels of the innovation process

The innovative object itself represents the first level. It is the artifact of the process. It can be a technology, a process, a service or a product. Its nature evolves during the process: from an idea, to a technical or marketing concept, a specification form, a sum of solutions, a prototype… As a consequence, the status of the new object is alternatively a sum of knowledge or a concept. Thus, Hatchuel at al. (Hatchuel, 1999) suggest a general theory of design activities that enable a better understanding of the process at the "object level". They describe the existing interrelation between the knowledge space (information and data collected by designers) and the concept space (non demonstrable notions taken into account by designers when deciding on the characteristics of the future product). At the same research level, the TRIZ [1] theory may be applied. For example, the eight technology evolution laws.

The second suggested level is the project. It is the design activities support level. The project is a complex system of acting people, resources and actions. They are federated in order to satisfy a demand coming from marketing or top management. Its major characteristic remains its time limitation. Project management is a major concern at this level. But note that differences have to be taken into account between innovative and non-innovative projects.

The global company and its particular way of managing innovation constitute the third level. It is the level of global mastery of the innovative potential of the unit and includes, among others, know-how, methods, experiences, and incentives. This domain is concerned with strategy, culture and general organizational schemes. We will go into detail on this level in the following chapters.

[1] The pillar of the Theory of Inventive Problem Solving (TRIZ) is the realization that contradictions can be methodically resolved through the application of innovative solutions. This is one of three premises upon which the theory is built: 1) the ideal design is a goal, 2) contradictions help solve problems, and 3) the innovative process can be structured systematically.

Individuals and groups of people represent the fourth level. It is the level of learning processes and cognitive assets (Baharadwajb, 2000). Depending on their vision of their role within the company, employees may or may not become important acting people, influencing just their direct environment or spreading newness throughout the organization.

It should be noted that, depending on the level under consideration, researchers may use different scientific approaches and models. This point constitutes the basic principles of an innovation engineering domain with its own theories, concepts, methodologies and tools.

In this article, our major concern will be the description of the innovation process at the "enterprise level". Regarding the complexity and the multiplicity of descriptive variables, we chose to follow a step by attributes. Our third hypothesis thus consists in suggesting that the description of the innovation process requires the census of attributes. A description and evaluation of processes will then be possible thanks to indicators relative to observable facts, which are themselves the characteristics of the attributes of the process.

The remainder of this article is organized as follows. The next section describes the research approach. In the subsequent sections, results are presented and finally the last section discusses the analytical findings and outlines some areas for future research.

## 3. Operating Research Procedure

We built our research protocol according to the following stages:

- bibliographical census of the main attributes of innovating processes,
- classification of these attributes into families,
- validation of the attribute families by an expert enquiry.

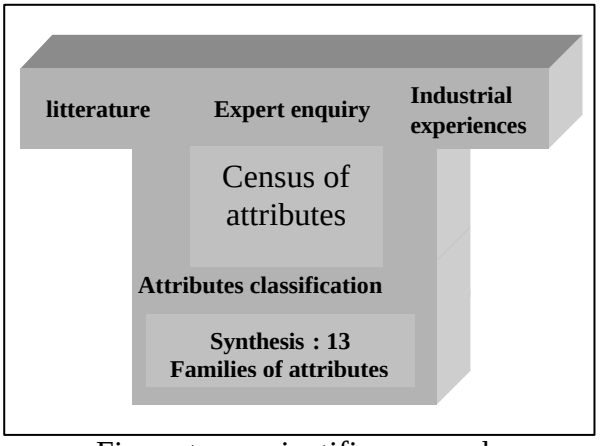


Figure two: scientific approach

The bibliographical study, a prerequisite for the census of attributes of innovating processes, was based on many reviews, with a particular analysis of the works dealing with the best practices of the North-American School (GRIFFIN, 1997).

The authors made the classification of attributes during three days of synthesis. Fifty experts from French speaking universities were polled; they were selected according to their scientific production in the field of innovation.

During the attributes validation stage, we confronted our representation with the vision of experts. This research step is consistent with a scientific and constructivist approach. We used the colored table of REGNIER. This method is used to collect and process experts' opinions using colored votes. The questions dealing with the research object are expressed as affirmations or items (annex 1). These items are submitted to the critical point of view of experts by mail (we used the Internet). All experts give their opinion by indicating a color. If they answer dark green, they mean they totally agree with the items proposed. If they totally disagree, they answer bright red. The expert can use pastels to express moderate opinions (pale green: I agree, orange: very moderate opinion, pink: disagree). By using a matrix in which experts and items are crossed, the opinions collected form a colored mosaic. By setting the matrix data diagonally, it is possible to classify items and to notice the emergence of opinion groups.

This method presents many advantages. It allows intuitive opinions to be collected, self- censorship is restricted, the playful aspect of color allows experts to express categorical opinions more easily, and it enables the information to be processed in a quantitative and qualitative manner.

## 4. Results

### *4.1. Census of attributes*

We have thus classified the groups of data in 13 families of attributes. Of course, the aim of this classification is just to explain innovating processes more easily; it does not correspond to a model.

**Attribute 1:** evolution of the project in progress by works of design. It deals with the technical dimension of the project construction.

**Attribute 2:** the follow-up of each innovating project in progress by the project manager. The piloting of a system-project implies four basic activities: planning, organizing, directing and controlling. Piloting also includes management actions since it deals with federating human capacities and with generating creativity.

**Attribute 3:** global supervision of the innovating project in progress (budget, deadlines...) by integrating the strategic dimension urged by top management. Strategic solutions for the short and long term must be found and some of the following decisions have to be considered: the resources to allocate to the project, the actions to launch concerning the environment, the specific strategic decisions related to the project studied according to corporate strategy, and decisions to stop, continue or reorientate the project (Alexander, 2002).

**Attribute 4:** coherence between the different innovating projects in progress within a portfolio of projects managed by the board of directors. According to Cooper (Cooper, 1997), this portfolio strategy must take into account: the maximization of the portfolio value, the balance between the short-term and long-term opportunities, geographical areas..., and the coherence with the global strategy.

**Attribute 5:** creation of a favorable work context (particularly the organization). Nowadays, the literature essentially refers to reflections concerning interdepartmental teams.

**Attribute 6:** control and retroaction from top management and the project-manager on the development process of innovation. It deals with a capacity to organize a continuous reengineering of the piloting practices of innovating processes, either concerning project management, or concerning the creation of teams in charge of initiatives, or more global operations.

**Attribute 7:** optimum allocation of the capacities (particularly human resources) needed for the innovation process: training, recruitment, remuneration, management (stimulation of autonomy and empowerment), the increase of interdepartmental relations (sharing of a sense of development, customer logic...), and career evolution.

**Attribute 8:** moral support of the people involved in the innovation process. According to the literature, one can, a priori, notice two contradictory phenomena: the need of support for

people who are confronted with the uncertainty of the innovating process, and the impulse to innovate which is generated by emerging situations.

**Attribute 9:** capitalization of know-how and experience gained during the implementation of previous projects for the benefit of the projects in progress and future projects. One can notice three major results for this capitalization system: to be able to use old results again, avoid overcosts due to redundancy in the work, and widen the references of the work groups, particularly during the solution research phases.

**Attribute 10:** Surveys of the macro-environment in order to have real information concerning external opportunities or threats (technologies, economy, competitors, market) (Leifer, 2000). Information must be collected outside the firm, transmitted and explained inwards.

**Attribute 11:** Management of the potential networks in which the firm is integrated. One can notice a marked increase in the development of partnership actions between companies.

**Attribute 12:** collective learning among the members of the group-projects as the projects progressively develop. The company is a community inside which capacities are developed, accumulated, sharpened and transformed. Industries must produce and distribute knowledge inwards and thus, they must seek to be more intelligent.

**Attribute 13:** collecting new ideas emerging from the research and development department, from marketing or employee proposals, in order to create future projects.

### *4.2. Results of the expert opinion poll*

The aim is to validate our classification. The thirteen attributes were submitted to fifty experts. We collected a colored vote for each expert and each attribute. This vote translates agreement or disagreement with the statement: “this attribute is a fundamental practice of innovation process management in innovative companies”. We also listed all remarks relating to each of the thirteen attributes. With these expert answers, we were able to establish the colored mosaic of opinions and a list of suggestions. Thus, we evaluated whether our list is meaningful with an exhaustive description of observable phenomenon in innovation.

### *4.3. Results of the expert inquiry*

The experts make a clear distinction between design and innovation. Indeed, it is possible to design or conceive of something without generating novelty. Moreover, some current trends aiming at strongly structuring the design process in firms seem to be antinomic with the notion of innovation. Experts refer to five basic activities in their comments to Attribute 1 about design practices. They suggest that defining the role of the people involved in innovation is a key factor for success. This includes the definition of the individuals and collective responsibilities. For example: Is the multidepartmental team dedicated to innovation allowed to take decisions or only to propose scenarios to top management? Setting the budgets, agendas and resources is an important task. Some experts focus on the formalization step. They insist on the importance of a precise and collective definition of all the problems to be solved during the projects (some experts note the role of external advisers at this stage). The problem solving phases constitute another fundamental sequence of the process. Nowadays, diverse software greatly facilitates the work of designers. Other experts highlight the key role of experimentation phases. The technical evaluation of design decisions is not the only aspect. The acceptability of the future product has to be assessed. The notion of coherence between the characteristics of the product and the way it will be used by customers is a basic criterion. Finally, experts suggest that the use of collective information systems constitutes an asset. To sum up, the experts' remarks on Attribute 1 concern the initialization of the project, problem modeling, problem solving, experimentation and validation of design choices, and communication between acting people.

Three major axes seem to characterize innovation:

Firstly, one deals with strategy (Attribute 3). The experts consider that the innovation process integrates a double phenomenon: innovation must be a process of materialization of predefined strategy and, by producing uncertain results, innovation implies the redefinition of a strategy which allows new opportunities to be seized. The technological strategy is a major concern of innovative company top management. The basic questions are: how to improve, optimize and protect the know-how that creates differentiation from the company's competitors.

Secondly, many experts state that the innovation process is mainly a process of creation of new knowledge, which relies on the emergence of specific capacities: creativity, breaking with routine, etc. This leads to a paradox between optimization (reinforcing the technical capacities) and innovation (changing the referential). The consensus relative to

attributes 8, 9, 10 and 12 shows the importance of the human dimension and even of the cognitive dimension of the innovation process.

This opinion is reinforced by the votes concerning attribute 11 and the opening of the firm to the outside world. Strategy, specific capacities and opening to the outside world are thus three crucial points in the process.

One can notice that this vision of innovation as a process of knowledge production is reinforced by the analysis of attributes 8, 10 and 13. Indeed, the experts insist on the notion of collective learning. Innovation does not only consist in piloting projects, which will turn into economically profitable activities for the company, it is also an opportunity to learn and acquire knowledge (particularly scientific knowledge).

The firm's capacity to diffuse new knowledge inwards represents an important variable in corporate success. For the experts, it is important to make the investments in R and D profitable. All knowledge acquired during the implementation of projects cannot be used by the firm in the short-term. Knowledge must thus be capitalized for future use. Nevertheless, one can notice that the reference to past data can reduce the degree of employee creativity. The experts emphasize the importance of research that will generate paths for technological development and they also reiterate the challenges and obstacles linked to the definition of an efficient research policy.

However, a significant number of experts state that partnership is not a systematic solution. It is the third main outcome of this inquiry. Different opinions appear as far as industrial property is concerned. Its importance is not challenged, but some limits are emphasized: difficulties for SMEs, reduction of application fields .The attributes linked to strategy (global or portfolio) are the object of many discussions. Three fundamental remarks appear: customer orientation, the coherence between strategy and financial capacity, and, above all, the importance of betting and risk-taking.

Some complementary opinions appear that clarify innovation management approaches.

Innovation managers gain useful insight by developing entrepreneurship within their companies. The ability to break the rules (Olin, 2001) of the organization is highlighted by some experts. They consider that newness is linked with the capacity of top management to delegate responsibilities.

The question of rewards does not seem to have been solved yet. Some experts state that money motivates people to take risks and as a consequence stimulates people involved in innovation. Rewards may be given to individuals or groups. On the other hand, some experts

suggest that rewards constitute a limitation to innovation. During the creation phases, designers often choose between different scenarios. Financial reward systems risk prioritising the simplest solution instead of the best option regarding the project objectives.

Our study emphasises the importance of the technological monitoring process aiming at updating knowledge of new technology development. More precisely, the experts' attention is particularly directed toward the valorisation of the data collected. Records available through surveys have to be transformed into analysed information: one way is to confront data with the expertise and experience of several people.

Moreover, this enquiry has enabled us to offer some thoughts on the evolution of knowledge management. The experts focus on know-how capitalisation software. These systems help classify data and non-formal know-how. Finally, it is possible to use previously acquired information in future projects.

## 5. Discussion and Conclusion

This description of the innovation process using attributes leads to some comments. Attribute 1 concerning design is discussed, and thus, the experts lead the reflection towards a vision of innovation as a process of adaptation, or action, by the firm to its environment. This process is highly complex and uncertain as some terms used by the experts show: risks, confidence, right to be wrong... Innovation appears to be at the center of the confrontation between the company and science. All the attributes allow a better understanding of the innovation process at the "enterprise level". They clarify how companies manage a continuous process: generating new projects continuously, piloting them and constructing genuine know-how in innovation engineering. Of course, this list of attributes can be completed or established in a different manner. But it allows us to depict the phenomena observable in situ in firms thanks to the themes it integrates. At this time, we have 13 attributes and 130 observable phenomena. This is why we consider that our work constitutes a first step toward obtaining a descriptive and predictive model of innovating processes.

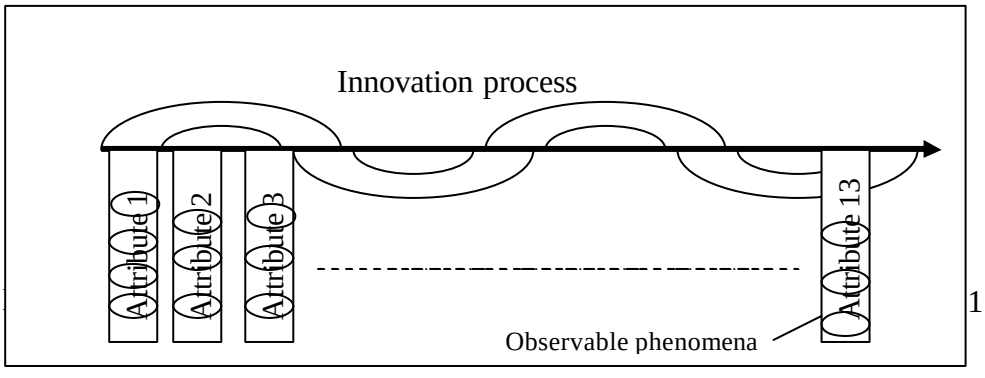

Figure 3: First stage of our innovating process model

The main generic attributes have been extracted thanks to the experimental and conceptual knowledge of experts. In addition to this research, we are also able to highlight, for each attribute, a list of observable phenomena. We are currently finalizing research concerning a dashboard of indicators that will help us to evaluate, for each phenomenon, the quality of the innovating process and therefore a company's global capacity to innovate.(Corona Armenta, 2005).

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**ANNEX 1 : Innovating process Items – Regnier colored table.**

| HOW TO EXPRESS YOUR OPINION |
|---|

You must put a cross and only one on the color of your choice.

**The examples below show you how to state your opinion :**

**I totally agree …….**


**I agree ……**


**I have a moderate opinion …….**


**I don't really agree …**


**I don't agree at all …...**


**I can't express myself……..**


**I don't want to express myself……..**


| THE CONDITIONS TO FILL<br>IN ORDER TO INNOVATE |
|---|

**What are the fundamental tasks for companies to innovate in the long term? At this stage of reflection, we don't seek to precise attributes in this list of tasks.**

***Item 1 : To innovate in the long term is to ensure of technical or organizational design tasks...***

| **Comments :** |
|---|

***Item 2 : To innovate in the long term is to have a system of project management (deadlines, costs, project review, planning...)***

**Comments :**

***Items 3 : To innovate in the long term is to develop or to enrich new product design methods (products, processes or organization)***

**Comments:**

***Items 4 : To innovate in the long term is to define the development strategy of the firm and to take into account the strategic choices in the decisions made on each project.***

**Comments:**

***Items 5 : To innovate in the long term is to manage the coherence within the portfolio of projects ( for firms that lead several projects)***

**Comments :**

***Items 6 : To innovate in the long term is to rethink and to readjust regularly the organization of the firm in order to study and then adopt the launched innovation (interdepartmental team ...)***

**Comments :**

***Items 7 : To innovate in the long term is to implement actions in order to develop key-capacities of innovation (to be creative, to question routine, to integrate technical, financial, legal, marketing data...)by training, recruitment, internal management,...***

**Comments :**

***Items 8 : To innovate in the long term is to implement collective training (by analyzing how each action or each project could bring new knowledge).***

**Comments :**

***Items 9 : To innovate in the long term is to create or take advantage of crisis situations in order to urge innovation.***

**Comments :**

***Items 10 : To innovate in the long term is to capitalize knowledge and know-how of previous projects in order to valorize better the investment in studies for future projects.***

**Comments :**

***Items 11 : To innovate in the long term is to open the firm to the outside world, (relations with universities, lecturers...) and to undertake technological monitoring.***

| **Comments :** |
|---|

***Items 12 : To innovate in the long term is to identify one's action areas (geography, time, technology, image and brand) by knowing one's industrial property rights and those of the competition***

| **Comments :** |
|---|

***Items 13 : To innovate in the long term is to organize a production of new ideas inwards : research, collection of the proposals of the staff***

| **Comments :** |
|---|

***Items 14 : To innovate in the long term is to assure and protect one's rights in one's field of action (geography, time, technology, image and brand)***

| **Comments :** |
|---|

***Items 15 : To innovate in the long term is to create and/or to integrate partnership networks***

| **Comments :** |
|---|

***I wish to complete the analysis :***

| **Personal remarks : *to innovate with a long term view, is also …. :*** <br>• <br>• <br>• |
|---|

**Name** :

**First name :**

**Firm :**

**Adress where you can receive the synthesis of all the participant opinions. (NB : guaranteed anonymity/ we can communicate with Email)** :